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(54) **CHARGING SOCKET AND BRACKET FOR CHARGING SOCKET**

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B60L 53/16 (2019.01)
H02J 7/00 (2006.01)

(52) **U.S. Cl.**

CPC **H01R 13/633** (2013.01); **B60L 53/16** (2019.02); **H02J 7/0045** (2013.01); **H01R 2201/26** (2013.01)

(58) **Field of Classification Search**

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See application file for complete search history.

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(57) **ABSTRACT**

A charging socket includes a fixed part, a charging opening, and a break member. A fixed part is configured to be fixed to an electric vehicle. A charging opening is to be inserted to a power feeding connector for charging a battery of the electric vehicle. A break member is configured to break and separate the charging opening from the fixed part when a predetermined amount or more of load is applied to the charging opening.

20 Claims, 6 Drawing Sheets

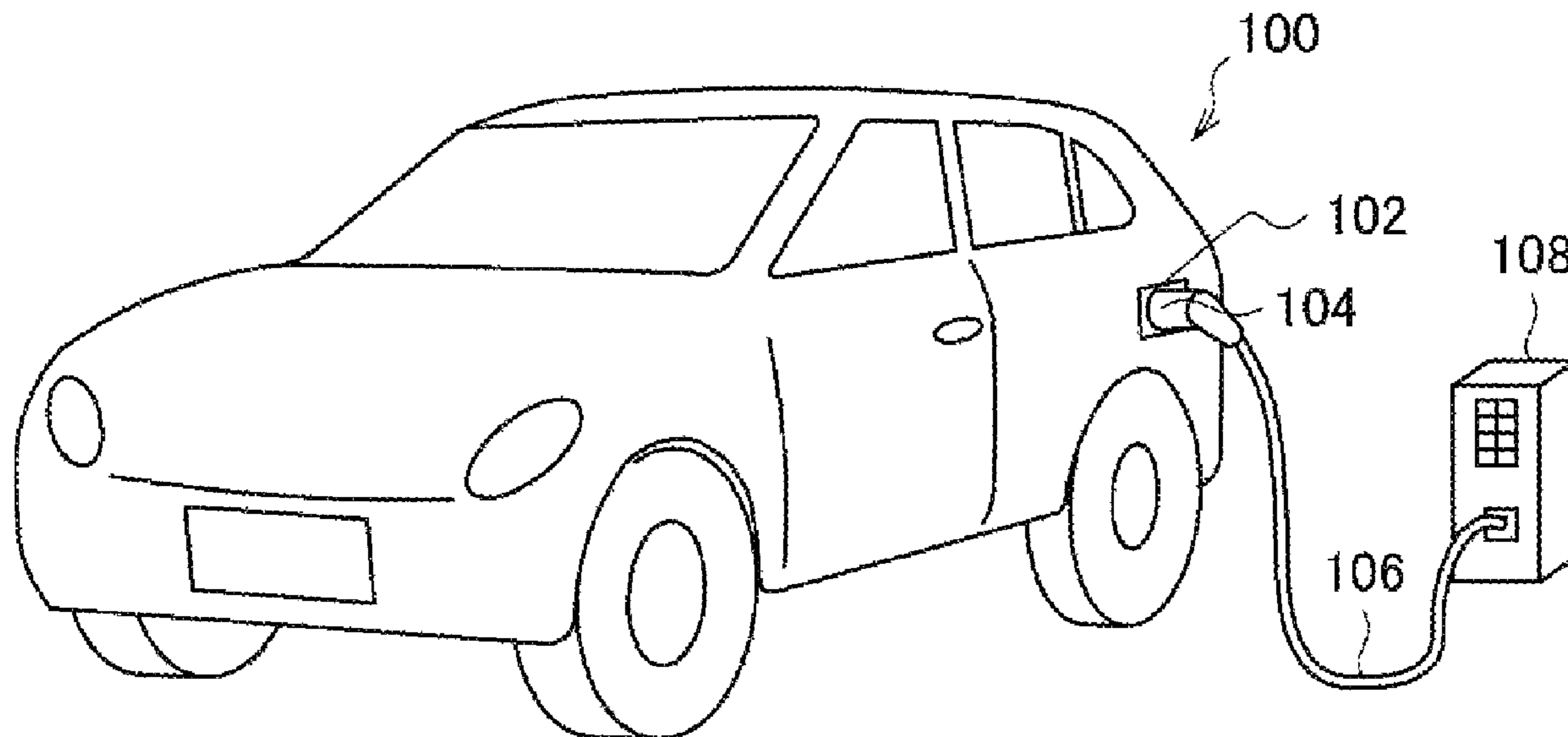


FIG. 1

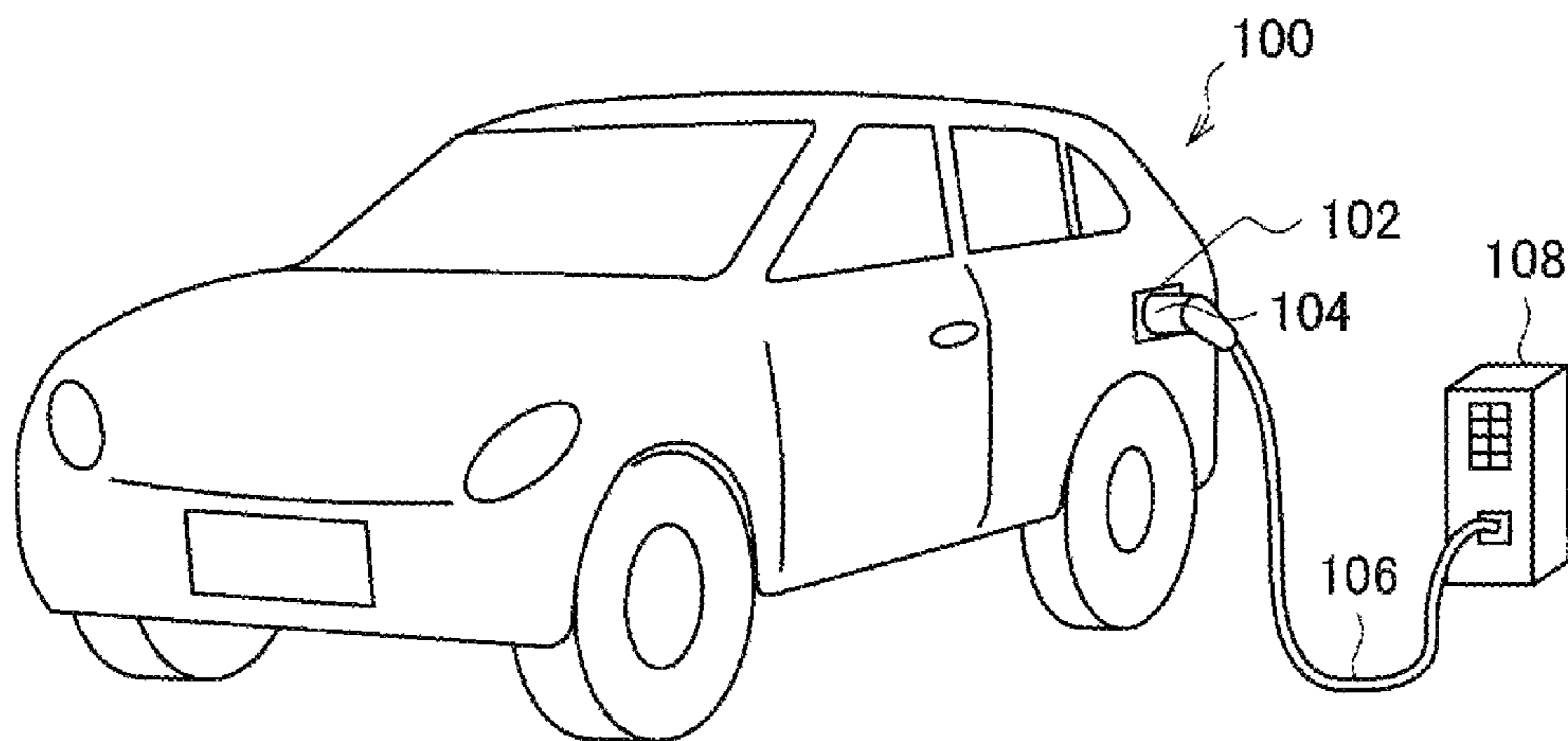


FIG. 3

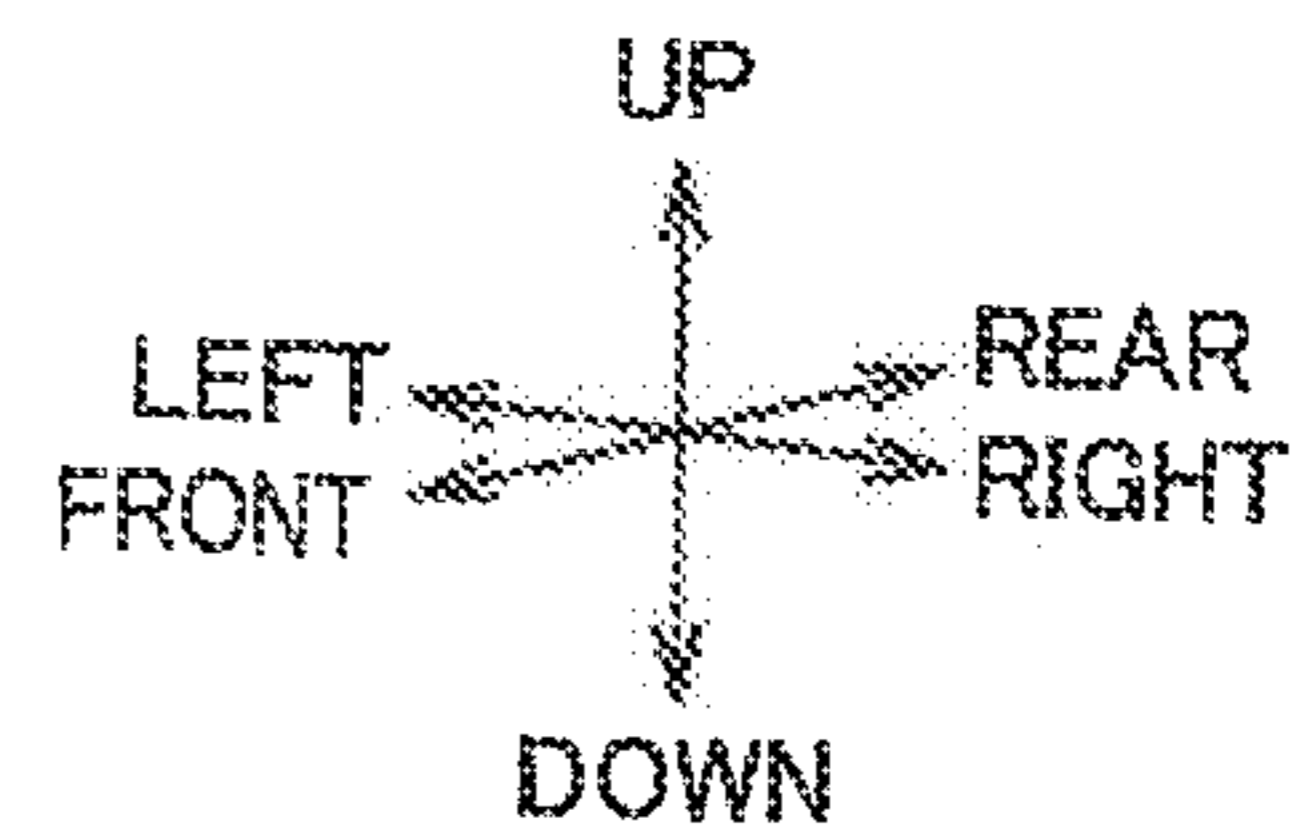
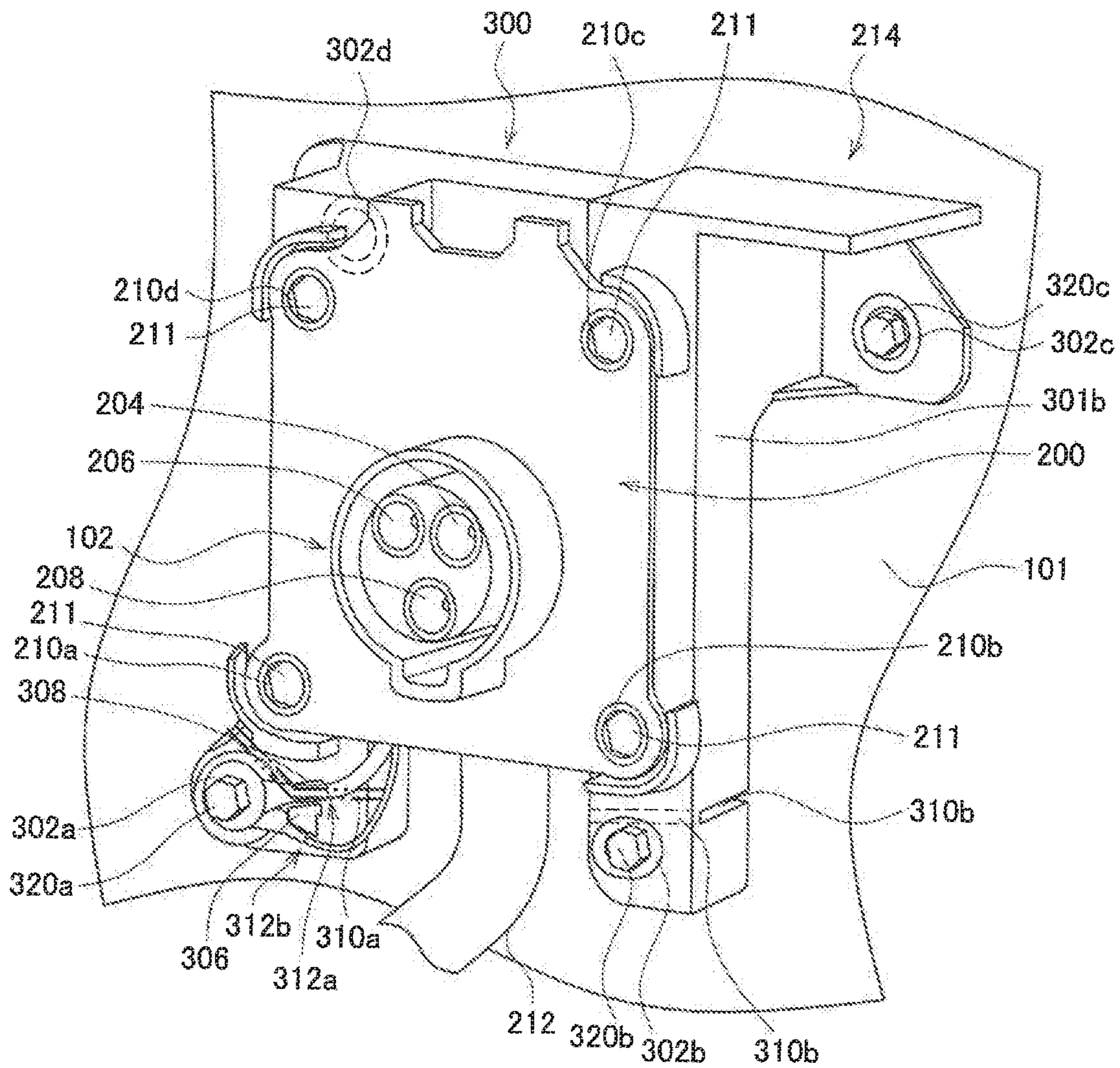


FIG. 4

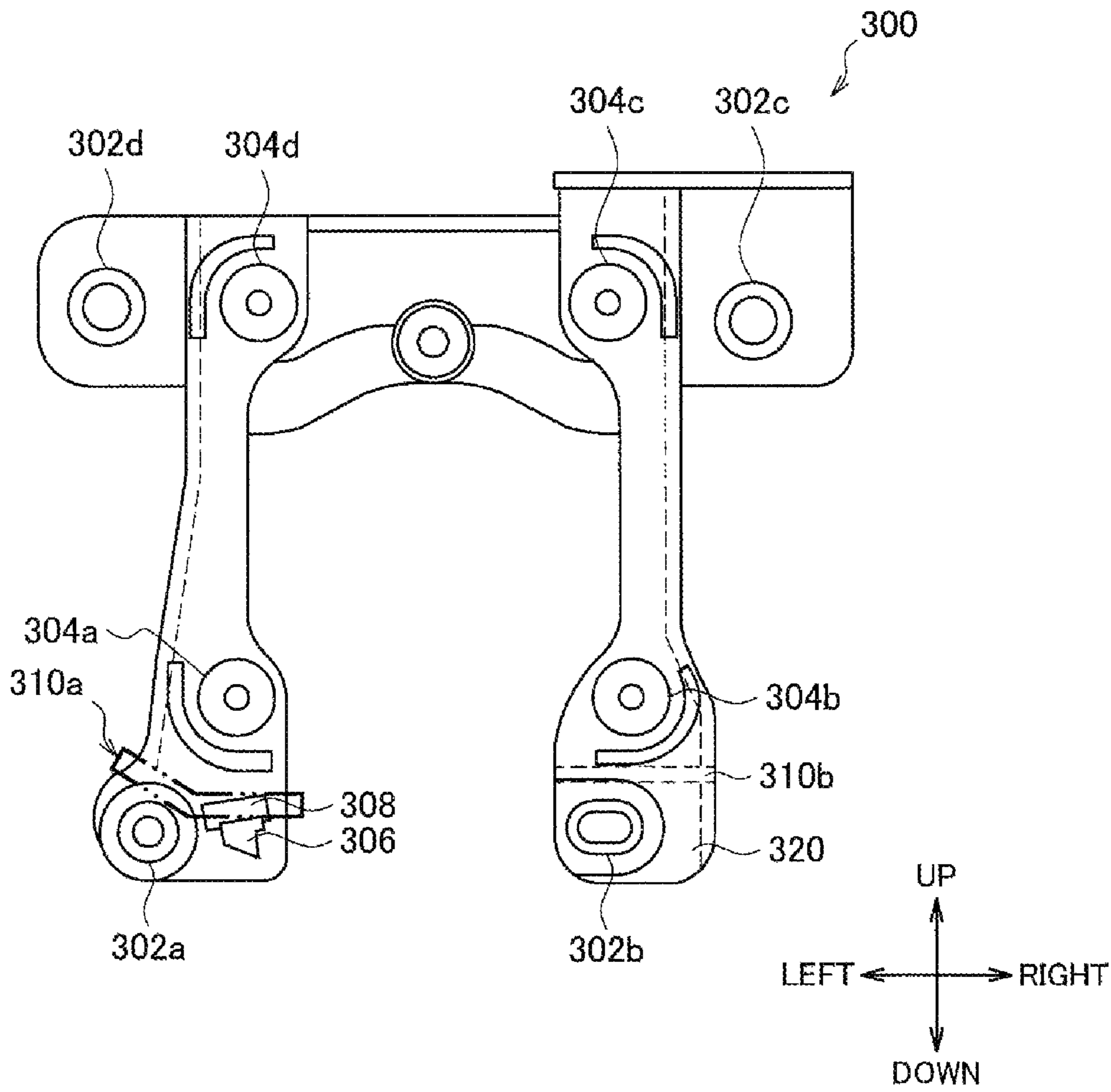


FIG. 5

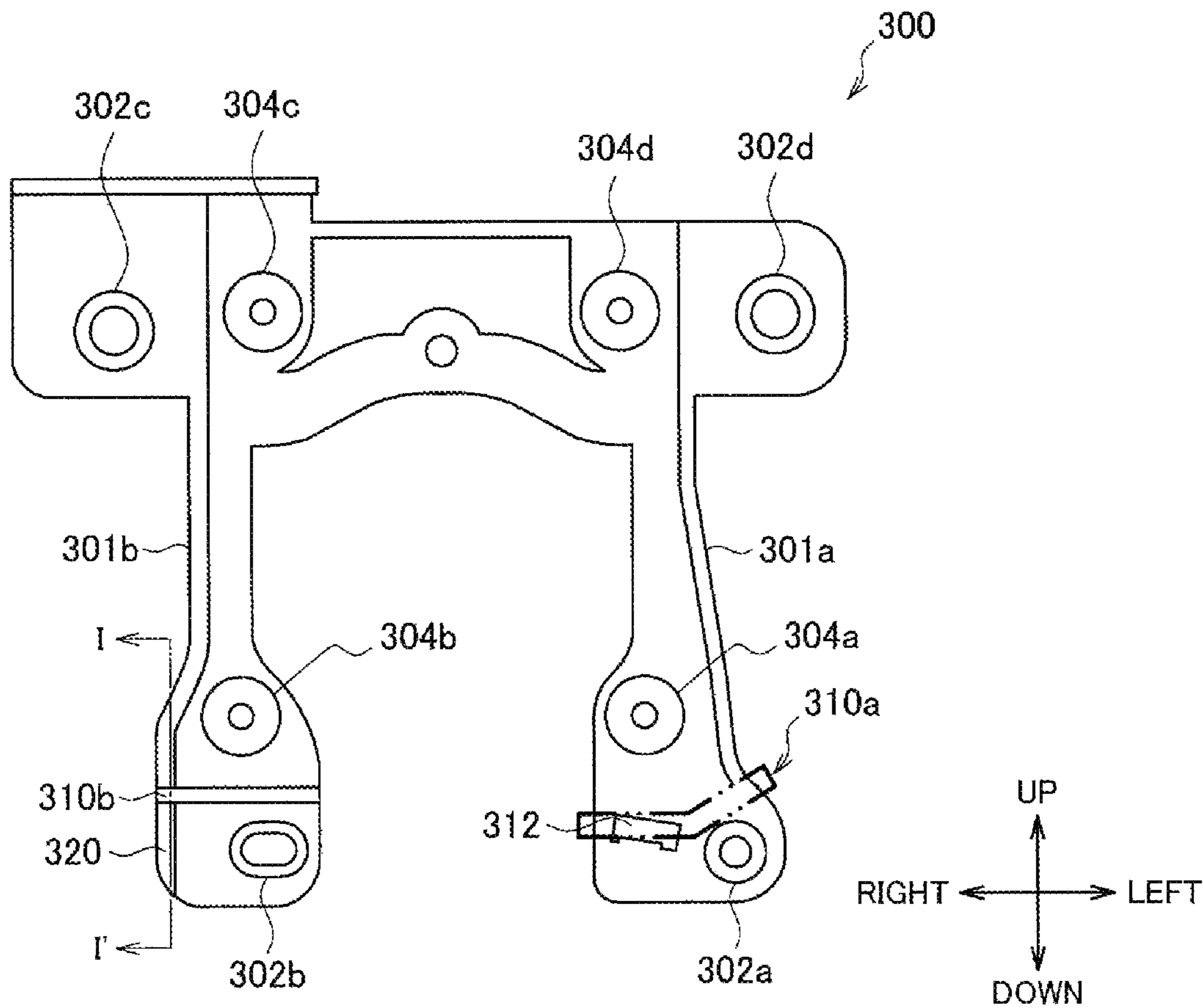


FIG. 6

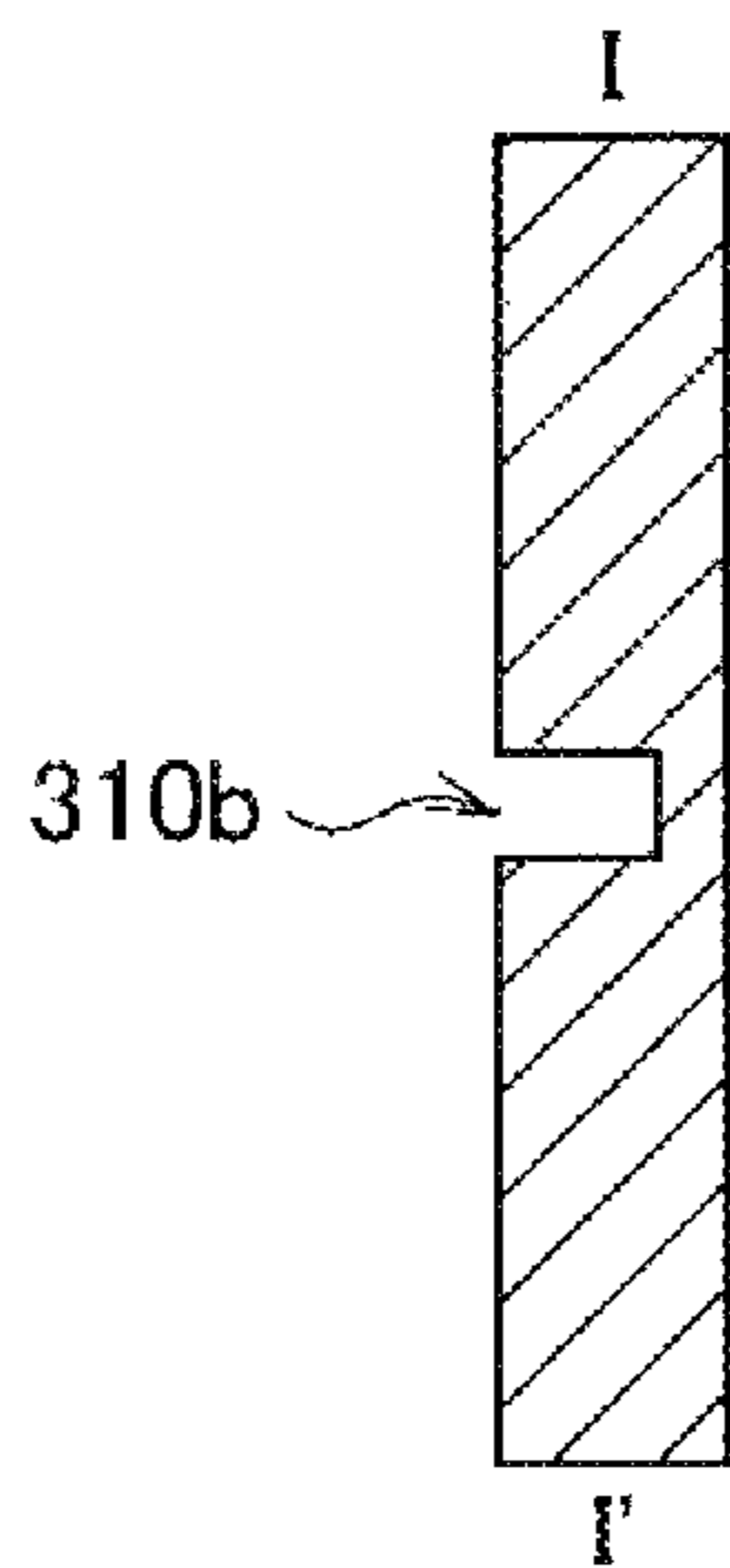
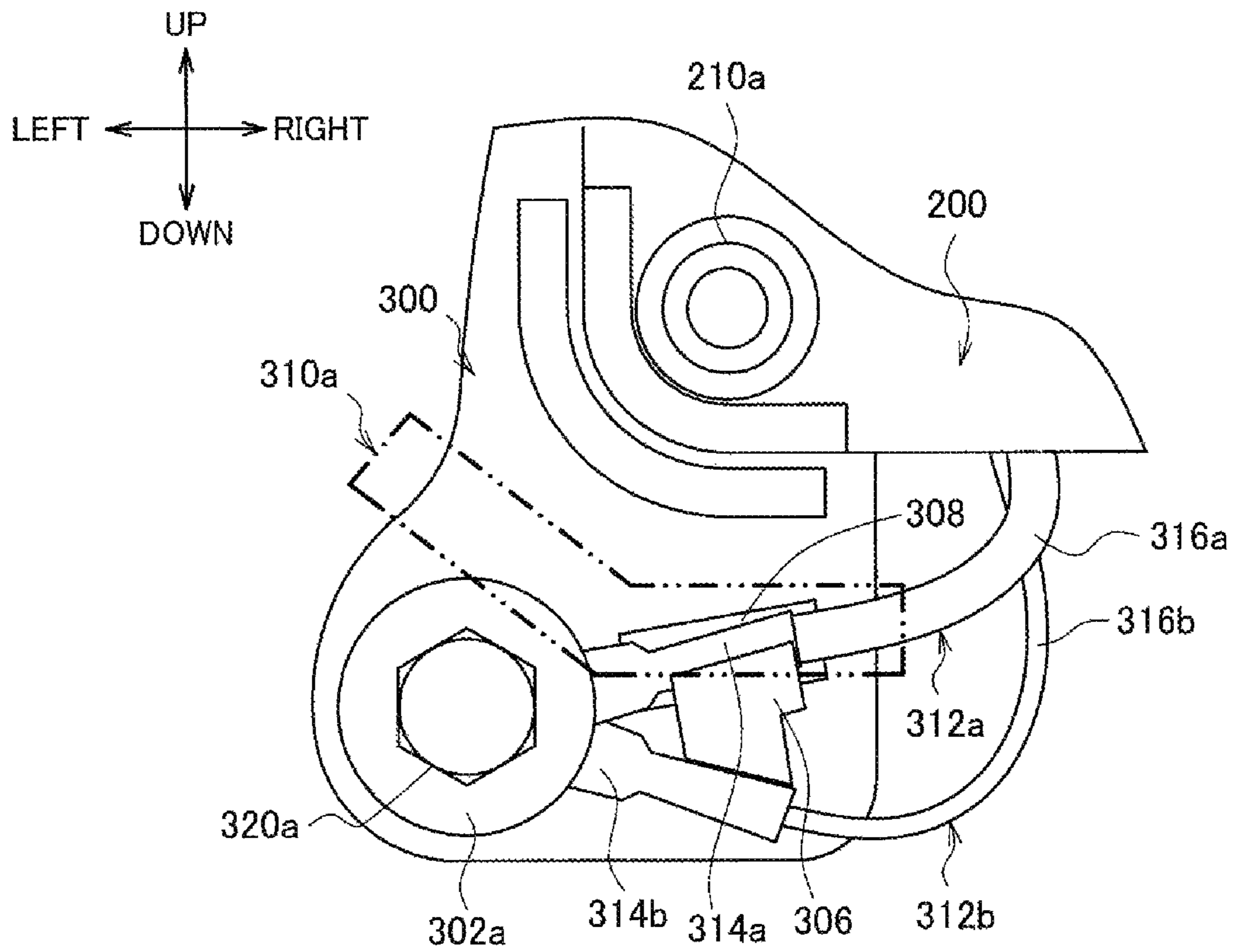


FIG. 7



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CHARGING SOCKET AND BRACKET FOR CHARGING SOCKET

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority from Japanese Patent Application No. 2018-113239 filed on Jun. 14, 2018, the entire contents of which are hereby incorporated by reference.

BACKGROUND

The disclosure relates to a charging socket and a bracket for the charging socket.

Electric motors that are driven by electric power are installed in an electric vehicle such as an electric car or a hybrid car. When the electric power of a battery for driving the electric motors is consumed, it is necessary to charge the battery by using external power feeding equipment. The external power feeding equipment is coupled to a power feeding cable having a power feeding connector at its tip. The battery is charged when the power feeding connector is inserted into a charging opening of the electric vehicle.

On the other hand, technologies of coupling a connector to a vehicle have been known. For example, Japanese Unexamined Patent Application Publication (JP-A) No. 2002-262433 discloses a connector bracket that integrates a vehicle-attached bracket and a connector bracket via a coupler. The vehicle-attached bracket is attached to a vehicle-side bracket, and a connector is attached to the connector bracket. The coupler breaks when impact of a set value or more is made on the connector bracket. At this time, the vehicle-attached bracket separates from the connector bracket. This assures safety of occupants.

SUMMARY

An aspect of the disclosure provides a charging socket including: a fixed part configured to be fixed to an electric vehicle; a charging opening to which a power feeding connector for charging a battery of the electric vehicle is inserted; and a break member configured to break and separate the charging opening from the fixed part when a predetermined amount or more of load is applied to the charging opening.

An aspect of the disclosure provides a bracket for a charging socket, the bracket including: a fixed part configured to be fixed to an electric vehicle; a coupler configured to be coupled to an inlet having a charging opening to which a power feeding connector for charging a battery of the electric vehicle is inserted; and a break member configured to break and separate the coupler from the fixed part when a predetermined amount or more of load is applied to the charging opening in a state where the inlet is coupled to the coupler.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the disclosure and are incorporated in and constitute a part of this specification. The drawings illustrate example embodiments and, together with the specification, serve to explain the principles of the disclosure.

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FIG. 1 is a perspective view of an electric vehicle that is being charged when viewed from a position in front of and to the left of the electric vehicle;

FIG. 2 is a perspective view of a charging socket according to an embodiment of the present disclosure when viewed from a position in front of and to the left of the charging socket, the charging socket being fixed to a vehicle body of the electric vehicle;

FIG. 3 is a perspective view of the charging socket according to the embodiment when viewed from a position in front of and to the right of the charging socket, the charging socket being fixed to the vehicle body of the electric vehicle;

FIG. 4 is a diagram illustrating a front surface of a bracket according to the embodiment;

FIG. 5 is a diagram illustrating a rear surface of the bracket according to the embodiment;

FIG. 6 is a cross-sectional view of the bracket according to the embodiment taken along a line I-I'; and

FIG. 7 is an enlarged diagram of the bracket to which ground electric wires according to the embodiment are fixed.

DETAILED DESCRIPTION

In the following, some embodiments of the disclosure are described in detail with reference to the accompanying drawings. Note that sizes, materials, specific values, and any other factors illustrated in respective embodiments are illustrative for easier understanding of the disclosure, and are not intended to limit the scope of the disclosure unless otherwise specifically stated. Further, elements in the following example embodiments which are not recited in a most-generic independent claim of the disclosure are optional and may be provided on an as-needed basis. Throughout the present specification and the drawings, elements having substantially the same function and configuration are denoted with the same reference numerals to avoid any redundant description. Further, elements that are not directly related to the disclosure are unillustrated in the drawings. The drawings are schematic and are not intended to be drawn to scale. A charging opening of an electric vehicle is exposed to an outside of the electric vehicle. Therefore, sometimes a large load may be applied to the charging opening. For example, an unexpectedly large load is applied to the charging opening when a person trips over a power feeding cable or when a body of a person or an object bumps the charging opening. When a load is applied to the charging opening made in the vehicle body of the electric vehicle, the load is also applied to the vehicle body of the electric vehicle. When an excessive load is applied to the charging opening, problems occur such as deformation of the charging opening and the vehicle body of the electric vehicle. For example, it is difficult to repair the deformed vehicle body, and a repairing cost is necessary for repairing the deformed vehicle body.

However, the technology described in JP-A No. 2002-262433 is a technology based on an assumption of a situation in which a knee of an occupant hits a connector bracket installed near a driver's seat or feet of the occupant. In other words, the technology described in JP-A No. 2002-262433 is not designed for a situation in which a large load is applied to a connector bracket as described above. In addition, in general, the connector bracket installed under a driver's seat or a passenger seat is not designed for passing high current through a connector to charge a battery of an electric vehicle.

In addition, when a predetermined power of impact is made on a connector bracket part of the connector bracket

described in JP-A No. 2002-262433, the connector bracket is divided into the connector bracket part separates and a vehicle-attached bracket part that is attached to the vehicle. In the case where a power feeding connector is coupled to the connector bracket part, the connector bracket part coupled to the power feeding connector separates from the vehicle-attached bracket part when impact is made on the connector bracket part. In the case where high current for charging a battery of an electric vehicle passes through a power feeding cable including the power feeding connector, problems occur such as electric leakage from the power feeding connector when the connector bracket part separates from the vehicle-attached bracket.

Accordingly, it is desirable to provide a novel and improved charging socket and bracket for the charging socket that make it possible to reduce a load applied to a vehicle body of an electric vehicle when the load is applied to a charging opening.

1. Electric Vehicle

FIG. 1 is a perspective view of an electric vehicle 100 that is being charged when viewed from a position in front of and to the left of the electric vehicle 100. The electric vehicle 100 may be an electric car that uses only one or more electric motors for propulsion, or a hybrid vehicle that uses both electric motors and an engine for propulsion. For example, the electric vehicle 100 runs by using electric power from a battery such as a lithium-ion battery or a nickel metal hydride battery.

To the electric vehicle 100, a charging socket 214 (not illustrated in FIG. 1 but to be described later) is fixed. The charging socket 214 has a charging opening 102 to which a power feeding connector 104 is inserted. In the embodiment, the charging socket 214 having the charging opening 102 is fixed to a rear left side portion of the electric vehicle 100. Note that, the position of the charging socket 214 is not limited thereto. The charging socket 214 may be fixed to a rear right side portion of the electric vehicle 100, or may be fixed to any portion such as both a front left side portion and a front right side portion, or a front portion, or a rear portion of the electric vehicle 100.

A power feeding cable 106 is coupled to power feeding equipment 108 external to the electric vehicle 100. The power feeding cable 106 includes a power feeding connector 104 at its tip. The power feeding connector 104 is detachably inserted into the charging opening 102. When the power feeding connector 104 is inserted into the charging opening 102, the power feeding equipment 108 transmits electric power to a battery of the electric vehicle 100 via the power feeding cable 106. The battery of the electric vehicle 100 is charged in such a way.

2. Charging Socket and Bracket for Charging Socket According to Embodiment 2-1. Charging Socket According to Embodiment

FIG. 2 is a perspective view of the charging socket 214 according to the embodiment when viewed from a position in front of and to the left of the charging socket 214, the charging socket 214 being fixed to a vehicle body 101 of the electric vehicle 100. FIG. 3 is a perspective view of the charging socket 214 according to the embodiment of the disclosure when viewed from a position in front of and to the right of the charging socket 214, the charging socket 214 being fixed to the vehicle body 101 of the electric vehicle 100.

The charging socket 214 includes a bracket 300 and an inlet 200. The bracket 300 is fixed to the vehicle body 101, and the inlet 200 is positioned outside of the bracket 300 with respect to the vehicle body 101. The charging opening 102 to which the power feeding connector 104 is inserted is made near a center of a front surface of the inlet 200.

The inlet 200 has a substantially quadrilateral shape. The substantially quadrilateral inlet 200 includes a first coupler 210a, a second coupler 210b, a third coupler 210c, and a fourth coupler 210d at its four corners. Hereinafter, the couplers 210a, 210b, 210c, and 210d of the inlet 200 are referred to as inlet side couplers 210 by omitting the alphabets attached to the end of the reference signs, in a case where it is not necessary to particularly distinguish the couplers 210a, 210b, 210c, and 210d. Each of the inlet side couplers 210 has a hole to which a coupling bolt 211 is inserted into the inlet 200. The coupling bolts 211 are bolts for coupling the inlet 200 to the bracket 300.

The coupling bolts 211 are inserted into the respective inlet side couplers 210, and the coupling bolts 211 are tightened on the bracket 300. Accordingly, the inlet 200 is fixed to the bracket 300. In such a way, the inlet 200 is coupled to the bracket 300.

FIG. 2 and FIG. 3 include arrows that represent directions of up, down, left, right, front, and rear. The directions of up, down, left, right, front, and rear used here are defined regardless of directions of left, right, front, rear of the electric vehicle 100. The direction represented by an arrow from front to rear in FIG. 2 and FIG. 3 is a direction from the inlet 200 to the vehicle body 101, the direction being perpendicular to a surface of the inlet 200 on which the inlet side couplers 210 are installed. The direction represented by an arrow from left to right is a direction from the first coupler 210a to the second coupler 210b. The direction represented by an arrow from down to up is a rough direction from the first coupler 210a to the fourth coupler 210d, the direction being perpendicular to both the direction represented by the arrow from left to right and the direction represented by the arrow from front to rear.

The bracket 300 includes a first fixed part 302a, a second fixed part 302b, a third fixed part 302c, and a fourth fixed part 302d. Hereinafter, the fixed parts 302a, 302b, 302c, and 302d are referred to as fixed parts 302 by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the fixed parts 302a, 302b, 302c, and 302d. The fixed parts 302 are formed by creating holes in the bracket 300.

A first bolt 320, a second bolt 320b, a third bolt 320c, and a fourth bolt 320d are respectively inserted into the first fixed part 302a, the second fixed part 302b, the third fixed part 302c, the fourth fixed part 302d. Hereinafter, the bolts 320a, 320b, 320c, and 320d are referred to as fixing bolts 320 by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the bolts 320a, 320b, 320c, and 320d. The fixing bolts 320 inserted into the respective fixed parts 302 are tightened on the vehicle body 101. Accordingly, the bracket 300 is fixed to the vehicle body 101. In such a way, the charging socket 214 including the bracket 300 is fixed to the vehicle body 101 of the electric vehicle 100.

The inlet 200 has the charging opening 102 to which the power feeding connector 104 is detachably inserted. The charging opening 102 includes a minus terminal 204, a plus terminal 206, and a ground terminal 208. A charging cable 212 is coupled to a back side of the charging opening 102. The charging cable 212 is a cable for supplying electric power to the battery of the electric vehicle 100. When the

power feeding connector **104** is inserted into the charging opening **102**, a plus terminal and a minus terminal of the power feeding connector **104** are coupled to the minus terminal **204** and the plus terminal **206**. Accordingly, electric power of the power feeding equipment **108** is supplied to the battery of the electric vehicle **100** via the power feeding cable **106** and the charging cable **212**.

In addition, when the power feeding connector **104** is inserted into the charging opening **102**, a ground terminal of the power feeding connector **104** is coupled to the ground terminal **208**. As described later, the ground terminal **208** is grounded to the vehicle body **101**. Therefore, the power feeding connector **104** is grounded to the vehicle body **101**. Since the power feeding connector **104** is grounded, it is possible to prevent electric shock or the like from the power feeding connector **104**.

2-2. Bracket According to Embodiment

The bracket **300** has a left side wall **301a** on a left side of the bracket **300**, and has a right side wall **301b** on a right side of the bracket **300**. As illustrated in FIG. 2, the left side wall **301a** is formed in the up-down direction from the first fixed part **302a** to the fourth fixed part **302d**. For example, the thickness of the left side wall **301a** in the left-right direction is a substantially similar to a length from a left end of the left side wall **301a** to a left end of the inlet **200**. In addition, the thickness of the left side wall **301a** in the left-right direction is a substantially even thickness between the first fixed part **302a** to the fourth fixed part **302d**. In addition, the thickness of the left side wall **301a** in the front-rear direction gradually gets thinner as extending toward the down direction from the fourth fixed part **302d**. The thickness of the left side wall **301a** in the front-rear direction becomes the thinnest near a first break member **310a** (to be described later). Therefore, the thickness of the bracket **300** in the front-rear direction becomes the thinnest near the first break member **310a** in the area between the first fixed part **302a** and the fourth fixed part **302d**.

On the other hand, as illustrated in FIG. 3, the right side wall **301b** is formed in the up-down direction from the second fixed part **302b** to the third fixed part **302c**. For example, the thickness of the right side wall **301b** in the left-right direction is a substantially similar to a length from a right end of the right side wall **301b** to a right end of the inlet **200**. The thickness of the right side wall **301b** in the left-right direction is a substantially even thickness between the second fixed part **302b** and the third fixed part **302c**. The thickness of the right side wall **301b** in the front-rear direction becomes the thickest near the third fixed part **302c**. In an area below the position near the third fixed part **302c**, the thickness of the right side wall **301b** in the front-rear direction is substantially even thickness and is thinner than the thickness near the third fixed part **302c**.

FIG. 4 is a diagram illustrating a front surface of the bracket **300** according to the embodiment. FIG. 5 is a diagram illustrating a back surface of the bracket **300** according to the embodiment. FIG. 4 and FIG. 5 include arrows that represent directions of up, down, left, and right. The directions represented by the up, down, left, right arrows in FIG. 4 and FIG. 5 indicate the same directions as the arrows in FIG. 2 and FIG. 3. The front surface of the bracket **300** is a surface opposed to a rear surface of a surface on which the charging opening **102** of the inlet **200** is made, in a state in which the bracket **300** is coupled to the inlet **200**.

The bracket **300** may be made from resin such as polybutylene terephthalate (PBT) or polycarbonate.

The bracket **300** includes a fifth coupler **304a**, a sixth coupler **304b**, a seventh coupler **304c**, and an eighth coupler **304d**. Hereinafter, the couplers **304a**, **304b**, **304c**, and **304d** of the bracket **300** are referred to as bracket side couplers **304** by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the couplers **304a**, **304b**, **304c**, and **304d**.

The coupling bolts **211** are inserted into the respective inlet side couplers **210** of the inlet **200**. The inserted coupling bolts **211** are tightened in the bracket side couplers **304**. Accordingly, the first coupler **210a**, the second coupler **210b**, the third coupler **210c**, and the fourth coupler **210d** of the inlet **200** are respectively fixed to the fifth coupler **304a**, the sixth coupler **304b**, the seventh coupler **304c**, and the eighth coupler **304d** of the bracket **300**. In such a way, the inlet **200** is coupled to the bracket **300**.

The bracket **300** includes the first break member **310a** at an upper right side of the first fixed part **302a**, and includes a second break member **310b** above the second fixed part **302b**. Hereinafter, the break members **310a** and **310b** are referred to as break members **310** by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the break members **310a** and **310b**. As described later, the break members are easily breakable in comparison with the portions of the bracket **300** other than the break members **310**.

The first break member **310a** is disposed near the first fixed part **302a** at a lower left end of the bracket **300**. As described above, the thickness of the bracket **300** in the front-rear direction near the first break member **310a** is the thinnest in the area between the first fixed part **302a** and the fourth fixed part **302d**. The break member more easily breaks when a load is applied, as the thickness of the bracket **300** in the front-rear direction gets thinner. Therefore, the first break member **310a** breaks most easily when a load is applied to the area between the first fixed part **302a** and the fourth fixed part **302d**.

A terminal receiver **306** (to be described later) is disposed in an area surrounded by a dashed-two-dotted line, the area indicating the first break member **310a**. A terminal hole **308** is made above the terminal receiver **306**. The terminal hole **308** is made by creating a hole in the bracket **300**. The first break member **310a** breaks more easily because of the terminal hole **308** in addition to the bracket **300** having the thin thickness in the front-rear direction. Therefore, the first break member **310a** breaks when a predetermined load enough to deform the vehicle body **101** is applied.

As described later, when a load is applied to the charging opening **102**, the load is preferentially applied to the fixed parts **302**. Therefore, when the load is applied to the charging opening **102**, the load is also applied to a position near the first fixed part **302a** that is one of the fixed parts **302**. Subsequently, the load is applied to the first break member **310a** near the first fixed part **302a**. The first break member **310a** breaks when the first break member **310a** becomes impatient of the load. At this time, the first break member **310a** breaks in the left-right direction in the area indicated by the dashed-two-dotted line, the area including the terminal hole **308**. As described above, the first break member **310a** is easily breakable. Therefore, when a load is applied to the charging opening **102**, the first break member **310a** breaks before the vehicle body **101** and the charging opening **102** deform.

The first break member **310a** is disposed between the first fixed part **302a** and the fifth coupler **304a**. When the first

break member **310a** breaks, the first fixed part **302a** separates from the fifth coupler **304a**. At this time, the bracket side couplers **304** other than the fifth coupler **304a** also separate from the first fixed part **302a**. The inlet **200** is coupled to the bracket **300** via the bracket side couplers **304**. Since the inlet **200** has the charging opening **102**, the first fixed part **302a** separates from the charging opening **102** when the first break member **310a** breaks. In other words, the first fixed part **302a** separates from the charging socket **214** having the charging opening **102**.

When the first fixed part **302a** separates from the charging socket **214**, the charging socket **214** becomes released from the first fixed part **302a**. This weakens the fixation of the charging socket **214** to the vehicle body **101**. However, even after the first break member **310a** breaks, the charging socket **214** is still fixed to the vehicle body **101** via the fixed parts **302** other than the first fixed part **302a**. Therefore, the charging socket **214** is still fixed to the vehicle body **101** even after the first break member **310a** breaks, whereas the charging socket **214** becomes movable from the vehicle body **101** by human power.

On the other hand, the second break member **310b** is disposed between the second fixed part **302b** and the sixth coupler **304b**. When a load is applied to the charging opening **102**, the load is also applied to the second break member **310b** near the second fixed part **302b**. The second break member **310b** breaks when the second break member **310b** becomes impatient of the load. At this time, the second break member **310a** breaks along a groove formed on the rear surface of the bracket **300** in an area indicated by dashed lines. Here, the second break member **310b** is easily breakable due to the groove. Therefore, when a load is applied to the charging opening **102**, the second break member **310b** breaks before the vehicle body **101** and the charging opening **102** deform.

When the second break member **310b** breaks, the second fixed part **302b** separates from the sixth coupler **304b**. At this time, the bracket side couplers **304** other than the sixth coupler **304b** also separate from the second fixed part **302b**. The inlet **200** is coupled to the bracket **300** via the bracket side couplers **304**. Since the inlet **200** has the charging opening **102**, the second fixed part **302b** separates from the charging opening **102** when the second break member **310b** breaks. In other words, the second fixed part **302b** separates from the charging socket **214** having the charging opening **102**.

As described later, the first break member **310a** is breakable more easily than the second break member **310b**. Therefore, when a load is applied to the charging opening **102**, the first break member **310a** breaks first and then the second break member **310b** breaks. Accordingly, when the second break member **310b** breaks, the first break member **310a** has already been broken. At this time, the charging socket **214** separates from the two fixed parts **302** which are the first fixed part **302a** and the second fixed part **302b**. Therefore, in the case where the second break member **310b** is broken, the fixation of the charging socket **214** to the vehicle body **101** gets weaker than the case where only the first break member **310a** is broken. Therefore, the charging socket **214** becomes more movable from the vehicle body **101**.

The bracket **300** according to the embodiment is a substantially U-shaped bracket that surrounds the charging opening **102** in the state in which the inlet **200** is coupled to the bracket **300**. The first fixed part **302a** is disposed near a lower left end of the substantially inverted U shape. The second fixed part **302b** is disposed near a lower right end of

the substantially inverted U shape. The bracket **300** is not continuous between the first fixed part **302a** and the second fixed part **302b**. On the other hand, the bracket **300** is continuous between the third fixed part **302c** and the fourth fixed part **302d** in the left-right direction. Therefore, the portions near the first fixed part **302a** and the second fixed part **302b** are more easily breakable than the third fixed part **302c** and the fourth fixed part **302d**.

As described above, the bracket **300** is not continuous between the first fixed part **302a** and the second fixed part **302b**. Therefore, the first fixed part **302a** separates from the charging opening **102** when the first break member **310a** disposed above the first fixed part **302a** merely breaks. In a similar way, the second fixed part **302b** separates from the charging opening **102** when the second break member **310b** disposed above the second fixed part **302b** merely breaks. On the other hand, it is necessary to break two portions which are a lower portion and a right portion of the eighth coupler **304d** to separate the eighth coupler **304d** from the charging opening **102**. The same applies to a case where the seventh coupler **304c** separates from the charging opening **102**. On the other hand, it is possible to separate the first fixed part **302a** or the second fixed part **302b** from the charging opening **102** by breaking only one break member **310**. In other words, the first fixed part **302a** and the second fixed part **302b** separates from the charging opening **102** more easily.

The first fixed part **302a** is disposed at a left side of a position directly below the fifth coupler **304a**. On the other hand, the second fixed part **302b** is disposed almost directly below the sixth coupler **304b**. A distance between the first fixed part **302a** and the fifth coupler **304a** in the top-bottom direction is similar to a distance between the second fixed part **302b** and the sixth coupler **304b** in the top-bottom direction. Therefore, a distance between the first fixed part **302a** and the fifth coupler **304a** is longer than a distance between the second fixed part **302b** and the sixth coupler **304b**.

When a load is applied to the charging opening **102**, the load is also applied to the bracket **300** that is coupled to the inlet **200** having the charging opening **102**. The bracket **300** is coupled to the inlet **200** via the bracket side couplers **304**. Therefore, when the load is applied to the charging opening **102**, the load is also applied to the bracket side couplers **304**. In addition, the bracket **300** is fixed to the vehicle body **101** via the fixed parts **302**. Therefore, a load applied to the bracket **300** from the charging opening **102** is also applied to the fixed parts **302** of the bracket **300**.

When the load is applied to the charging opening **102**, the load is also applied to the fixed parts **302** via the bracket side couplers **304**. Here, the distance between the first fixed part **302a** and the fifth coupler **304a** is longer than the distance between the second fixed part **302b** and the sixth coupler **304b**. Therefore, according to the principle of leverage, a load applied to a portion near the first fixed part **302a** is larger than a load applied to a portion near the second fixed part **302b**. In addition, as described above, since the bracket **300** is the substantially U-shaped bracket, the portions near the first fixed part **302a** and the second fixed part **302b** are more easily breakable than the third fixed part **302c** and the fourth fixed part **302d**. In addition, the first break member **310a** is easily breakable because the left side wall **301a** near the first break member **310a** is thin. Therefore, the first break member **310a** is the most breakable portion in the bracket **300** when a load is applied to the charging opening **102**. In addition, the second break member **310b** is the second most

breakable portion in the bracket **300** after the first break member **310a**, when a load is applied to the charging opening **102**.

Next, function effects of the embodiment achieved in the case where the first break member **310a** breaks will be described. When a large load is applied to the charging opening **102**, the load is also applied to a portion near the fixed parts **302** fixed to the vehicle body **101**. Since the first break member **310a** is disposed near the first fixed part **302a**, a load is also applied to the first break member **310a** when the load is applied to the charging opening **102**. As described above, the left side wall **301a** near the first break member **310a** is thin in the front-rear direction, and the first break member **310a** has the terminal hole **308**. Therefore, the first break member **310a** is easily breakable. Accordingly, when a load is applied to the charging opening **102**, the first break member **310a** breaks in the area surrounded by the dashed-two-dotted line, the area including the terminal hole **308** as illustrated in FIG. 4.

When the first break member **310a** breaks, the first fixed part **302a** separates from the charging opening **102**. At this time, the vehicle body **101** is released from the load applied to the vehicle body **101** from the charging opening **102** via the first fixed part **302a**. Therefore, it is possible to comprehensively reduce a load applied to the vehicle body **101** from the charging opening **102** when the first break member **310a** breaks. As a result, it is possible to prevent the vehicle body **101** from deforming due to a load applied to the charging opening **102** and the vehicle body **101**.

In addition, the fixation of the charging socket **214** to the vehicle body **101** becomes unstable when the first break member **310a** breaks and the first fixed part **302a** separates from the inlet **200** having the charging opening **102**. Accordingly, the charging socket **214** easily deviates from a predetermined position. Specifically, the charging socket **214** easily deviates from the predetermined position in the front-rear direction. This causes a user to notice the abnormality. At this time, it is possible for the user to immediately stop charging the battery. Accordingly, it is possible to promptly suppress electric leakage. On the other hand, sometimes a load is still applied to the charging opening **102** even after the first break member **310a** breaks. In such a case, the charging socket **214** also deviates from the predetermined position easily, and it is easy for a user to notice the abnormality. Therefore, it is possible for the user to immediately remove the load applied to the charging opening **102** and the vehicle body **101**. Accordingly, it is possible to suppress deformation of the vehicle body **101** and the charging opening **102**.

Next, function effects of the embodiment achieved in the case where the second break member **310b** breaks will be described. FIG. 6 is a cross-sectional view of the bracket **300** according to the embodiment taken along a line I-I' illustrated in FIG. 5. Since the groove is formed on the rear surface of the bracket **300**, the second break member **310b** is thinner in comparison with portions of the bracket **300** other than the second break member **310b**. This enables the second break member **310b** to be easily breakable.

When an excessive load is applied to the charging opening **102**, the load is also applied to a portion near the fixed parts **302**. Since the second break member **310b** is disposed near the second fixed part **302b**, a load is also applied to the second break member **310b** when the load is applied to the charging opening **102**. Therefore, when a predetermined load is applied to the charging opening **102**, the load is also applied to the second break member **310b** and the second break member **310b** breaks. The fixed part **302b** separates

from the inlet **200** having the charging opening **102** in the case where the second break member **310b** breaks. As a result, the vehicle body **101** is released from the load applied to the vehicle body **101** from the charging opening **102** via the second fixed part **302b**. At this time, the first break member **310a** has already been broken, the first break member **310a** being more breakable than the second break member **310b**. Accordingly, the vehicle body **101** is released from the load applied to the vehicle body **101** from the charging opening **102** via the first fixed part **302a** and the second fixed part **302b**, in the case where the second break member **310b** breaks. In addition, when the second break member **310b** breaks, the fixation of the charging socket **214** to the vehicle body **101** becomes more unstable in comparison with the case where only the first break member **310a** breaks. For example, in the case where a user or the like who is near the vehicle body notices that the break members **310** are broken, it is possible for the user or the like who has noticed the breakage to remove a cause of the load applied to the charging opening **102**. It is possible to reduce the load applied to the charging opening **102** by removing the cause of the load applied to the charging opening **102**. Therefore, when the second break member **310b** breaks, a load applied to the vehicle body **101** is reduced more than the case where only the first break member **310a** breaks. As a result, it is possible to further prevent the vehicle body **101** from deforming due to the load applied to the charging opening **102**.

In addition, the second break member **302b** separates from the inlet **200** having the charging opening **102** when the second break member **310b** breaks. At this time, since the first break member **310a** is broken, the first fixed part **302a** is also separated from the inlet **200** having the charging opening **102**. Therefore, when the second break member **310b** breaks, the inlet **200** separates from the first fixed part **302a** and the second fixed part **302b**. At this time, the fixation of the charging socket **214** to the vehicle body **101** becomes more unstable than the case where only the first break member **310a** breaks. Therefore, it is easier for a user to notice the abnormality, and it is possible to immediately stop charging the battery. As a result, it is possible to prevent electric leakage before it happens.

2-3. Ground Electric Wire According to Embodiment

FIG. 7 is an enlarged diagram of the bracket **300** to which ground electric wires **312** according to the embodiment are fixed. FIG. 7 illustrates a portion near the first fixed part **302a**. On the rear side of the ground terminal **208** disposed in the charging opening **102** of the inlet **200**, a first ground electric wire **312a** and a second ground electric wire **312b** are coupled to the ground terminal **208**. Hereinafter, the ground electric wires **312a** and **312b** are referred to as ground electric wires **312** by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the ground electric wires **312a** and **312b**. The number of the ground electric wires may be one or more.

The first ground electric wire **312a** includes a first terminal **314a** and a first electric wire **316a**. The second ground electric wire **312b** includes a second terminal **314b** and a second electric wire **316b**. Hereinafter, the terminals **314a** and **314b** are referred to as terminals **314** by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the terminals **314a** and **314b**. In addition, the electric wires **316a**

and **316b** are referred to as electric wires **316** by omitting the alphabets attached to the end of the reference signs, in the case where it is not necessary to particularly distinguish the electric wires **316a** and **316b**. The terminals **314** are crimped to tips of the electric wires **316**. In such a way, the terminals **314** are electrically coupled to the electric wires **316**.

The first bolt **320a** is inserted into the hole of the first fixed part **302a** and the terminals **314** of the ground electric wires **312**, and is tightened on the vehicle body **101**. When the first bolt **320a** is tightened on the vehicle body **101**, the first fixed part **302a** of the bracket **300** is fixed to the vehicle body **101**. At this time, the terminals **314** are fixed to the first fixed part **302a**. In such a way, the terminals **314** of the ground electric wires **312** and the bracket **300** are jointly fastened to the vehicle body **101** via the first bolt **320a**.

In addition, both the first bolt **320a** and the vehicle body **101** of the electric vehicle **100** are made of metal. The terminals **314** of the ground electric wires **312** are also made of metal. Therefore, when the terminals **314** are tightened on the vehicle body **101** via the first bolt **320a**, the electric wires **316** that is electrically coupled to the terminals **314** are grounded to the vehicle body **101**. In such a way, the ground electric wires **312** are grounded. When the ground electric wires **312** are grounded, the ground terminal **208** in the charging opening **102** is also grounded. The power feeding connector **104** is also grounded in the case where the power feeding connector **104** is inserted to the charging opening **102**. Since the power feeding connector **104** is grounded, current flowing from the power feeding connector **104** flows to the vehicle body **101** via the ground electric wires **312** in the case of abnormality. Therefore, in the case of abnormality, it is possible to prevent electric shock from the power feeding connector **104** before it happens.

The bracket **300** includes the terminal receiver **306** on the right side of the first fixed part **302a**. The terminal receiver **306** is configured such that a portion of the bracket **300** below the terminal hole **308** protrudes toward the front side, and a front side of the terminal hole **208** is covered. There is a gap between a front surface of the bracket **300** and a rear surface of the terminal receiver **308** that covers a lower portion of the terminal hole **308**. The gap corresponds to a diameter of the first terminal **314a** in the front-rear direction. The first terminal **314a** is inserted into the gap between the front surface of the bracket **300** and the rear surface of the terminal receiver **308** that covers the lower portion of the terminal hole **308**. The first terminal **314a** is held such that the first terminal **314a** is sandwiched between the front surface of the bracket **300** and the rear surface of the terminal receiver **306**. On the other hand, the second terminal **314b** is disposed along a bottom surface of the terminal receiver **306** below the terminal receiver **306**.

Next, function effects of the ground electric wires **312** according to the embodiment achieved when the first break member **310a** breaks will be described. The first fixed part **302a** separates from the inlet **200** having the charging opening **102** in the case where a load is applied to the charging opening **102** and the first break member **310a** breaks. At this time, the terminals **314** of the ground electric wires **312** are still fixed to the first fixed part **302a**. In addition, the first fixed part **320a** is still fixed to the vehicle body **101** via the first bolt **320a**. Accordingly, the terminals **314** are still fixed to the vehicle body **101**. On the other hand, when the first break member **310a** breaks, the first fixed part **302a** separates from the inlet **200** having the charging opening **102**. Accordingly, the charging socket **214** is

released from the first fixed part **302a**. As a result, the charging socket **214** becomes movable from the vehicle body **101**.

Sometimes a load continues to be applied to the charging opening **102** even after the first break member **310a** breaks. At this time, the charging opening **102** of the charging socket **214** is pulled in a direction in which the load is applied. When the charging opening **102** is pulled, the terminals **314** of the ground electric wires **312** are pulled from the first fixed part **302a** toward the charging opening **102**. When the terminals **314** are pulled with great force toward the charging opening **102**, the crimped portions break and the terminals **314** separate from the electric wires **316**. In such a way, the terminals **314** are electrically disconnected from the electric wires **316**. In other words, the ground electric wires **312** are disconnected. When the ground electric wires **312** are disconnected, a signal indicating the disconnection of the ground electric wires **312** is transmitted to the power feeding equipment **108**. The power feeding equipment **108** stops feeding the power when the power feeding equipment **108** receives the signal. In such a way, it is possible to prevent electric leakage from the power feeding connector **104** without continuing the power feeding. As described above, according to the embodiment, it is possible to stop charging a battery by breaking the break members **310** and disconnecting the ground electric wires **312**. Therefore, it is not necessary to prepare a mechanism for stopping charging a battery in addition to the charging socket **214**.

2-4. Effects of Embodiment

As described above, according to the embodiment, the break member **310** breaks and the fixed part **302** separates from the charging opening **102** when an excessive load is applied to the charging opening **102**. When the fixed part **302** separates from the charging opening, it is possible to eliminate the load applied to the fixed parts **302** via the bracket side couplers **304** from the charging opening **102**. As a result, it is possible to eliminate the load applied to the vehicle body **101** via the fixed parts **302** from the charging opening **102**, and it is possible to comprehensively reduce the load applied to the vehicle body **101**. In such a way, the load applied to the vehicle body **101** from the charging opening **102** is comprehensively reduced, and it is possible to suppress deformation of the vehicle body **101** and the charging opening **102**. Accordingly, it is possible to prevent the electric vehicle **100** from becoming unusable and it is possible to cut a cost for repairing an expensive vehicle body **101**.

In addition, with regard to the charging socket **214** according to the embodiment, the inlet **200** separates from the bracket **300** when the coupling bolts **211** inserted into the inlet side couplers **210** are removed. Therefore, according to the embodiment, it is possible to separate the inlet **200** from the bracket **300**. Accordingly, it is only necessary to replace the bracket **300** with a new one in the case where the bracket **300** is broken. In other words, it is not necessary to replace the whole charging socket **214** to repair the bracket **300** if the bracket **300** is broken. Therefore, it is possible to reduce a cost for repairing the charging socket **214**.

3. Modification Embodiment

Although the preferred embodiments of the disclosure have been described in detail with reference to the appended drawings, the disclosure is not limited thereto. It is obvious to those skilled in the art that various modifications or

variations are possible insofar as they are within the technical scope of the appended claims or the equivalents thereof. It should be understood that such modifications or variations are also within the technical scope of the disclosure.

According to the embodiment, the fixing bolts **320** are tightened on the vehicle body **101** when the fixing bolts **320** are inserted into the holes of the fixed parts **302** on the bracket **300** as illustrated in FIG. 2 and FIG. 3. Accordingly, the bracket **300** is tightened on the vehicle body **101**. In such a way, the charging socket **214** including the bracket **300** is fixed to the vehicle body **101**. A method of fixing the charging socket **214** to the vehicle body **101** is not limited thereto. For example, a catch may be installed on the vehicle body **101** and the bracket **300** may be engaged with the catch. Alternatively, the charging socket **214** may be fixed to the vehicle body **101** in a state in which another member is interposed between the bracket **300** and the vehicle body **101**.

According to the embodiment, the coupling bolts **211** are inserted into the inlet side couplers **210** of the inlet **200**, and the coupling bolts **211** are tightened on the bracket **300**, as illustrated in FIG. 2 and FIG. 3. In such a way, the inlet **200** is fixed to the bracket **300**, and the inlet **200** is coupled to the bracket **300**. A method of coupling the inlet **200** to the bracket **300** is not limited thereto. For example, a catch may be installed on the bracket **300** and the inlet **200** may be engaged with the catch. Alternatively, the inlet **200** may be coupled to the bracket **300** in a state in which another member is interposed between the inlet **200** and the bracket **300**.

According to the embodiment, the inlet **200** separates from the bracket **300** when the coupling bolts **211** inserted into the inlet side couplers **210** are removed. The embodiment is not limited thereto. The inlet **200** and the bracket **300** may be permanently affixed such that they are not separated from each other.

As illustrated in FIG. 2 to FIG. 5, the two break members **310** which are the first break member **310a** and the second break member **310b** are installed according to the embodiment. However, the embodiment is not limited thereto. The number of the break members **310** may be one, or the number of the break members **310** may be three or more. In addition, the break members **310** may be disposed on the inlet **200**, or the break members **310** may be disposed on the inlet **200** and the bracket **300**. In addition, the break members **310** may be made from the same material as the portions of the bracket **300** other than the break member **310**, or may be made from material different from the portions of the bracket **300** other than the break member **310**.

According to the embodiment, one of the fixed parts **302** separates from the charging opening **102** when the one or two break members **310** break. However, the embodiment is not limited thereto. The fixed part **302** may be separated from the charging opening **102** when three or more break members **310** break. Alternatively, two or more fixed parts **302** may separate from the charging opening **102** when one of the break members **310** breaks.

According to the embodiment, a user himself/herself recognizes that the charging socket **214** deviates from the vehicle body **101** by seeing breaking of the break member **310** when the break member **310** breaks. Accordingly, it is possible for the user to notice that an excessive load is applied to the charging opening **102** and to stop feeding power from the power feeding equipment **108**. However, the embodiment is not limited thereto. The charging socket **214**

may include a detection device for detecting breaking of the break members **310**. In the case where the charging socket **214** includes the detection device, the detection device may stop feeding power from the power feeding equipment **108** when the detection device detects breaking of the break member **310**.

According to the embodiment, the bracket **300** is a substantially U-shaped bracket that surrounds the charging opening **102** in the state in which the bracket **300** is coupled to the inlet **200**, as illustrated in FIG. 4 and FIG. 5. However, the embodiment is not limited thereto. The bracket **300** may have a rectangular shape, a circular shape, an oval shape such that the bracket **300** surrounds the charging opening **102**.

According to the embodiment, the second break member **310b** is breakable due to the groove formed on the rear surface of the bracket **300** as illustrated in FIG. 5 and FIG. 6. However, the embodiment is not limited thereto. The groove may be formed on the front surface of the bracket **300**, or grooves may be formed on both the front and rear surfaces. In addition, groove or the like may be formed on the break member **310** such that the bracket **300** becomes thinner in the left-right direction.

In addition, according to the embodiment, the first break member **310a** breaks first and then the ground electric wires **312** gets disconnected as described with reference to FIG. 7. However, the embodiment is not limited thereto. The ground electric wires **312** may become disconnected at the same time as breaking of the first break member **310a**.

According to the embodiment, the first break member **310a** breaks and then the ground electric wires **312** are pulled toward the charging opening **102** by a load applied to the charging opening **102**. Subsequently, the crimped portions break, the terminals **314** separate from the electric wires **316**, and the ground electric wires **312** gets disconnected in the case where the load is large. However, the embodiment is not limited thereto. The ground electric wires **312** may be disconnected through electric wires **316**. Alternatively, it is also possible to install another mechanism for disconnecting the ground electric wires **312** when the break member **310** breaks.

The invention claimed is:

1. A charging socket, comprising:

at least one fixed part configured to be fixed to an electric vehicle;

a charging opening to which a power feeding connector for charging a battery of the electric vehicle is to be inserted, the charging opening being connected to the at least one fixed part via a coupling member such that the coupling member is electrically connected to the at least one fixed part; and

a break member configured to break and separate the charging opening from the at least one fixed part when a predetermined amount or more of load is applied to the charging opening such that the coupling member electrically disconnects from the at least one fixed part.

2. The charging socket according to claim 1, wherein the at least one fixed part comprises multiple fixed parts, and wherein the break member separates one or more of the multiple fixed parts from the charging opening.

3. The charging socket according to claim 1, further comprising:

a bracket that comprises the at least one fixed part; and an inlet that includes the charging opening and that is configured to be coupled to the bracket.

4. The charging socket according to claim 3, wherein the bracket comprises the break member.

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5. The charging socket according to claim 4, wherein the break member comprises a groove formed on the bracket.

6. The charging socket according to claim 4, wherein the break member includes a hole.

7. The charging socket according to claim 4, wherein the bracket includes a substantially U-shaped bracket configured to surround the charging opening.

8. The charging socket according to claim 7, wherein the at least one fixed part is disposed in a vicinity of at least one of both ends of the substantially U-shaped bracket, and wherein the break member is disposed in a vicinity of the at least one fixed part.

9. The charging socket according to claim 1, further comprising:

an inlet that includes the charging opening and the coupling member includes an electric wire coupled to the charging opening.

10. The charging socket according to claim 9, further comprising:

a bracket that comprises the at least one fixed part and is electrically connected to the electric wire.

11. The charging socket according to claim 10, wherein the bracket comprises an electric wire fixing part connected to the electric wire.

12. The charging socket according to claim 11, wherein the electric wire fixing part separates from the charging opening when the break member breaks.

13. The charging socket according to claim 12, wherein the electric wire becomes disconnected when the electric wire fixing part separates from the charging opening.

14. The charging socket according to claim 9, wherein the electric wire comprises a ground electric wire.

15. The charging socket according to claim 14, wherein the ground electric wire becomes disconnected when the at least one fixed part separates from the charging opening.

16. A charging socket, comprising:

a bracket that comprises rises at least one fixed part configured to be fixed to an electric vehicle;

an inlet that comprises a charging opening to which a power feeding connector for charging a battery of the electric vehicle is to be inserted, the inlet being configured to be coupled to the bracket, and the charging opening being coupled to the at least one fixed part, wherein the inlet further comprises a ground electric wire coupled to the charging opening,

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wherein the bracket further comprises an electric wire fixing part, and

wherein the ground electric wire is fixed to the electric wire fixing part; and

a break member configured to break and separate the charging opening from the at least one fixed part when a predetermined amount or more of load is applied to the charging opening such that the ground electric wire is disconnected from the electric wire fixing part.

17. The charging socket according to claim 16, wherein the electric wire fixing part separates from the charging opening in a state in which the break member has broken, and

wherein the ground electric wire becomes disconnected in a state in which the electric wire fixing part separates from the charging opening.

18. The charging socket according to claim 17, wherein the ground electric wire and the bracket are jointly fastened to the electric vehicle at the electric wire fixing part.

19. A bracket for a charging socket, the bracket comprising:

at least one fixed part configured to be fixed to an electric vehicle;

a coupler configured to be coupled to an inlet of the charging socket, the inlet including a charging opening to which a power feeding connector for charging a battery of the electric vehicle is to be inserted, the charging opening being connected to the at least one fixed part via a coupling member such that the coupling member is electrically connected to the at least one fixed part; and

a break member configured to break and separate the coupler from the at least one fixed part when a predetermined amount or more of load is applied to the charging opening in a state where the inlet is coupled to the coupler such that the coupling member electrically disconnects from the at least one fixed part.

20. The bracket for a charging socket according to claim 19, wherein the at least one fixed part comprises multiple fixed parts, and

wherein the break member separates one or more of the multiple fixed parts from the charging opening.

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